

SCIENCE

FRIDAY, APRIL 13, 1888.

DESPITE THE SNEERS in some quarters, and vacillation in others, where neither sneers nor vacillation are becoming, the movement in favor of manual training is proceeding with remarkable vigor and rapidity. Ex-Pres. Rutherford B. Hayes recently delivered an excellent address on the subject before the Ohio Legislature, and in the cities of St. Paul and Detroit the school boards are now considering favorable reports presented by special committees on the subject. The Detroit report is so thoroughly representative of the way in which competent school boards are proceeding, that we quote a portion of it. It contains the following passage: "The bulk of our children cannot make a living except through hand-work: intellectual training alone is therefore an insufficient preparation for life, so far as they are concerned. Man is by nature a tool-user. As much of his superiority comes from his skilful hands as from his brain. Neglect to educate his hand, and you deprive him of a large portion of his power. The hand is the peer of the intellect: it executes what the mind conceives. The most brilliant ideas are shorn of their splendor if the hand is without the necessary skill to express them. The hand and the mind should receive equal culture. True education looks after the whole man: any education short of this is a failure. To make man a harmonious being, such as he was intended to be by his Creator, all his powers must be equally developed. Such development, according to Everett, was found in Washington, of whom he said that he reminded him of a circle, every point in whose circumference is equally distant from the centre. The present system of education is strongly biased in favor of professional and literary pursuits, to which there would be no objection were every man's vocation in life, law, medicine, theology, or kindred avocations. But these are not the callings for which the majority are intended. The average man must earn his bread by the sweat of his brow, and must be a producer, in order to obtain support. Manual labor has fallen into disrepute among us, and the result is that the great majority of our young men go into the professions, while we have to go abroad for skilled mechanics. The professions are overstocked, and two-thirds of their members earn precarious livings. Those who do not seek the professions join the huge army of poorly paid clerks and book-keepers, or become Micawbers, dawdling away life 'waiting for something to turn up.' The condition of our girls is still worse. They, too, have been taught to look down upon labor, and their only hope of support is inherited wealth or fortunate marriage. The poor have no fortunes to leave behind them, and the divorce courts tell us that marriage is, alas! too seldom 'love in a cottage.' How shall all this be remedied? By the manual-training school. Educate the hand side by side with the head, and you will dignify labor. The principal reason why the professional man is treated with respect, while the mechanic is regarded as a mere drudge, is because the one is something outside of his pursuit, while the other is practically nothing. There is as much nobility in a piece of fine cabinet work as in a bill in chancery, and yet the world does not think so. Why? Because the lawyer is a man of general intellectual culture, while the mechanic is the contrary. Mix brain with any thing, and you ennoble it. Make a man the victim of mere routine, and you degrade him. No matter how skilful he may be, he will rank no higher than a mere automaton. In fact, the automatic machine which he tends in the shop is considered his superior. All through the centuries, intellectual pursuits have been favored, while manual labor has been treated with disrespect, if not scorn. Plato tells us, in his 'Repub-

lic,' that God made men of gold, of silver, and of iron; that those made of the first-named material were intended to be our rulers, those made of the second were to be their assistants, while those made of the third were placed on earth to be hewers of wood and drawers of water. Plato could not see any dignity in mere manhood. Were he alive to-day, however, he would have a higher appreciation of the man of toil. He would learn that this era of the world is termed the reign of the people, and that in the future their pursuits are to be esteemed as highly as the pursuits of those who win bread and fame by the tongue and the pen. This esteem will be accorded to them, not because the achievements of the tongue and the pen are unworthy of the honor which they have heretofore received, but because they will be brought into the service of the workshop. In this glorious future the tools of the artisan, and the books of the scholar, will be regarded as equal members of a happy brotherhood working together in beautiful harmony. As has been said, the son of Vanderbilt's brakeman will then have the same chance for success in life as the son of Vanderbilt. And when that blessed day comes, discontent among the laboring-classes will largely disappear, for no one will then be obliged to run the race of life handicapped with its present inequalities. Give us the manual-training school, and there will be less occasion for strikes, lock-outs, and anti-poverty societies." Whether all the beneficent economic and social effects that the report predicts will follow the introduction of manual training, is at best doubtful; but that the tenor of the report is sound is unquestionable.

CAPT. C. E. DUTTON, of the United States Geological Survey, is now engaged in writing his monograph on the Charleston earthquake. The reports upon which this will be based are complete, and in shape for the public printer. No earthquake of ancient or modern times has ever been observed with so great care and fullness of detail as has that of which the city of Charleston was so near the centre of disturbance. Almost nothing remains to be desired in this report. Besides the observations made by professors in several colleges, by hundreds of railroad officials, and at signal stations, hundreds of intelligent private citizens have reported their own experiences, giving to Captain Dutton a mass of data such as has not before been collected in regard to a dozen earthquakes. This material has, of course, all been carefully digested; and the conclusions which Captain Dutton will present in his monograph will constitute one of the most valuable additions to scientific knowledge yet made through the United States Geological Survey. The same volume will also contain a report on the Sonora earthquake, very abundant material for which has been collected in those portions of the United States to which the *temblor* extended. Mr. Goodfellow's report upon the phenomena of the epicentral region of the disturbance in Sonora was all that was needed to complete the desirable data. Both of these monographs will be ready for the printer by June 1, and an effort will be made to hasten their publication.

AN EXPERIMENT is being tried in Chicago which deserves success. A series of economic conferences between business-men and working-men has been arranged with the purpose of making business-men and working-men acquainted with each other's views. Business-men do not attend working-men's meetings, and only know of their proceedings and debates at second-hand. Similarly working-men have no appreciation of the magnitude and complexity of the problems with which business-men are daily confronted. The

Chicago conferences aim to remove this lack of mutual understanding and appreciation, and to pave the way for a better state of things in that strike-ridden city. The conferences are to take place on successive Sunday evenings, and are seven in number. There are four representatives of the working-men to speak: namely, George A. Schilling, on 'The Aims of the Knights of Labor'; Thomas J. Morgan, on 'The Labor Question from the Standpoint of the Socialist'; Joseph R. Buchanan, on 'A View from the Labor Sanctum'; and A. C. Cameron, on 'An American Trades-Unionist's View of the Social Question.' The business-men are allotted three representatives: Lyman J. Gage speaks on 'Banking and the Social System'; Charles L. Hutchinson, on 'Is the Board of Trade Hostile to the Interests of the Community?'; and Franklin MacVeagh, on 'Socialism as a Remedy.' Miscellaneous discussion is not to be allowed at these conferences, because of its obvious dangers; but at the conclusion of each address any one in the audience is to be at liberty to question the speaker on any point, provided the question is stated respectfully. It is hoped that such questions and answers will prove an instructive and profitable feature of each meeting. We shall await with considerable interest some account of these conferences, and their success.

SCHOOL OF MECHANIC ARTS AT THE ALABAMA POLYTECHNIC INSTITUTE.

SINCE manual training as a feature of general education is exciting increased interest, we are gratified to note the advance of this important movement in industrial education in the South, and present as a matter of interest to our readers the plan of the rooms and the scheme of work of the School of Mechanic Arts at the Alabama Polytechnic Institute, Auburn, Ala. This school is under the charge of Mr. George H. Bryant, a graduate of the Massachusetts Institute of Technology.

The department of mechanic arts at the Alabama Polytechnic Institute was organized in 1885, and during the summer of that year the motive plant for the whole department, and the machinery and equipment for the wood-working shop, were purchased and erected. The former consists of a 25-horse power Harris-Corliss engine, steam for which is supplied by a 30-horse power steel, horizontal, tubular boiler, for which a substantial brick boiler-house and chimney were erected.

The wood-shop occupies one half of a room 50×90 feet (the lower story of one of the college-buildings), the other half being taken for the machine-shop. The equipment for this shop comprises the following: 20 double wood-working benches, each with complete set of carpenter's tools; 20 turning-lathes, 10 inches swing, each with set of tools; 1 double circular saw; 1 band saw; 1 surface planer; 1 buzz planer; 2 scroll saws (power); 1 large pattern-maker's lathe; 1 36-inch grindstone. In addition to these, the tool-room is supplied with a variety of extra hand-tools for special work.

During the summer of 1886 a substantial brick building, 32×72 feet, one story high, with monitor roof, was built for the forge and foundry departments. This is divided into two rooms each 35×30 feet, each department occupying one room.

The equipment for the foundry consists of moulding-benches for twelve students, each supplied with a complete set of moulders' tools; a 14-inch cupola with all modern improvements; a brass furnace with a melting capacity of 100 pounds of brass at a heat, with a set of crucibles, tongs, etc.; also a full supply of ladles, large and small moulding-flasks, special tools, etc.

The forge-shop equipment consists of 12 forges of new pattern, each with anvil, set of smith's tools, etc. The blast for all the forges is supplied by a Sturtevant No. 3 steel pressure-blower (which also furnishes blast for the foundry cupola); and a No. 15 Sturtevant exhaustor draws the smoke from the fires, and forces it out through the chimney.

In the machine-shop are the following tools: 6 14 inches×6 feet engine-lathes; 2 16 inches×6 feet engine-lathes; 1 22×22 inches×5 feet friction-planer; 1 15-inch shaper; 1 20-inch drill-press; 1 Universal milling-machine; 1 post-drill 15 inches; 1 corundum tool-grinder; 1 bench emery-grinder. Chipping and filing benches for

twelve students, each with vise, set of files, chisels, hammers, etc., are provided, one-third of the shop being set apart for this work. In the tool-room are found a good variety of cutting and measuring tools, shop appliances, etc. The full course in mechanic arts runs through three years, as follows:—

First Year.—First term, elementary mechanical drawing (one month), carpentry; second term, carpentry, turning begun; third term, carpentry and turning alternating.

Second Year.—First term, pattern-making (six weeks), foundry-work begun, moulding and casting; second term, foundry-work finished, smithing begun in forge-room; third term, smithing.

Third Year.—First term, chipping and filing; second and third terms, machine-work in metals.

During the second year, lectures are given on moulding and casting, and the metallurgy of iron and steel, and in the third year occasional lectures on mechanical subjects connected with the shop-work.

A special course in steam and mill engineering, with practice with the apparatus, is provided for advanced students who wish to take extra or special work in practical mechanics. The average yearly attendance in this department during the past three years has been about ninety.

SOME SOCIAL AND ECONOMIC PARADOXES.¹

The Artificial is Superior to the Natural. — Reforms are Chiefly advocated and brought about by Those who have no Personal Interest in Them. — Discontent increases with the Improvement of the Social Condition, etc.

THE progress of science has always been jeopardized by two classes of persons, who, though the exact opposite of each other, are both constantly striving to circulate specious errors under its name. One of these classes of persons seeks to induce belief in improbable things, on the ground that most now accepted truth has once been held to be improbable. The other class seeks to shake confidence in established truths on the ground that they have not yet received mathematical demonstration. On the one hand, theories which are still awaiting proof, or which lie on the extreme confines between the known and the unknown, are taught as established truths; and, on the other hand, great principles whose establishment has cost ages of most laborious research are brushed aside as if they were but visionary hypotheses. The first class judges every thing by analogy; the second confronts every thing with a paradox.

The sincere searcher after truth has much more to do than merely to acquire a knowledge of the truth that has been made known: he has to distinguish between real truth and apparent truth; and this when the apparent truth is presented to him under all the outward guise of real truth, and when the real truth is presented to him in the form of error to be shunned. The two classes may therefore be called respectively 'analoguers' and 'paradoxers,' between whom the honest and uninitiated inquirer must run the gauntlet; and strong indeed must be that judgment that comes through unscathed. There will always be Stokeses and Zöllners to offer specious proofs of what seem impossibilities, as there will always be Lobatschewskys and Dr. Deemeses to question geometric opinion, and Dukes of Argyll to undo the work of Darwins.

When, therefore, we approach the subject of the paradoxes of nature, we must do so fully aware that we may be placed in the category of paradoxers in general, and fully prepared to have our paradoxes discounted accordingly. And while the physical paradoxes that the universe presents are most of them too well known in our day to admit of being called in question, as they all were when first announced, I fear that in the case of social and economic paradoxes there will be no body of truth to which appeal can be made.

I propose to point out a few of those propositions in sociology, and especially in political economy, which are now on trial, and to indicate what I regard as the probable verdict of history upon their truth or falsity. But in this latter task I do not arrogate to myself

¹ Paper read before the Anthropological Society of Washington, D.C., March 20, 1888, by Prof. L. F. Ward.

PLAN OF
WORKSHOPS
DEPARTMENT OF
MECHANIC ARTS

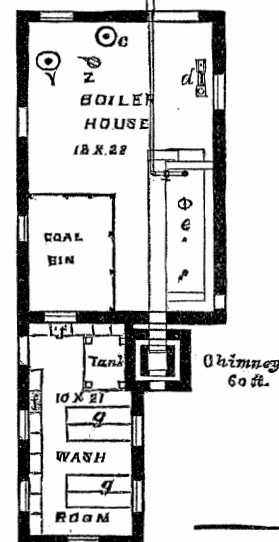
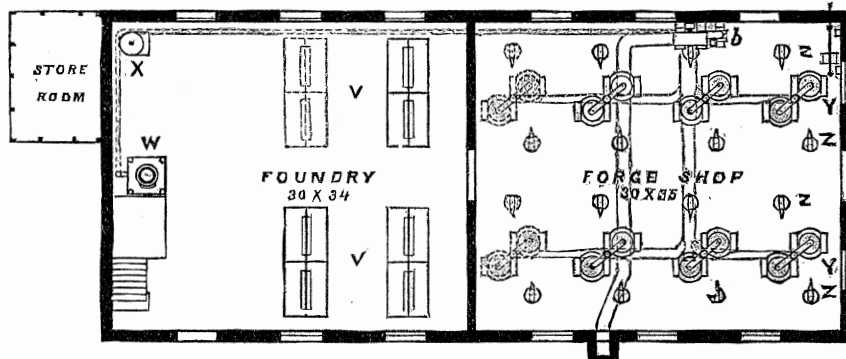
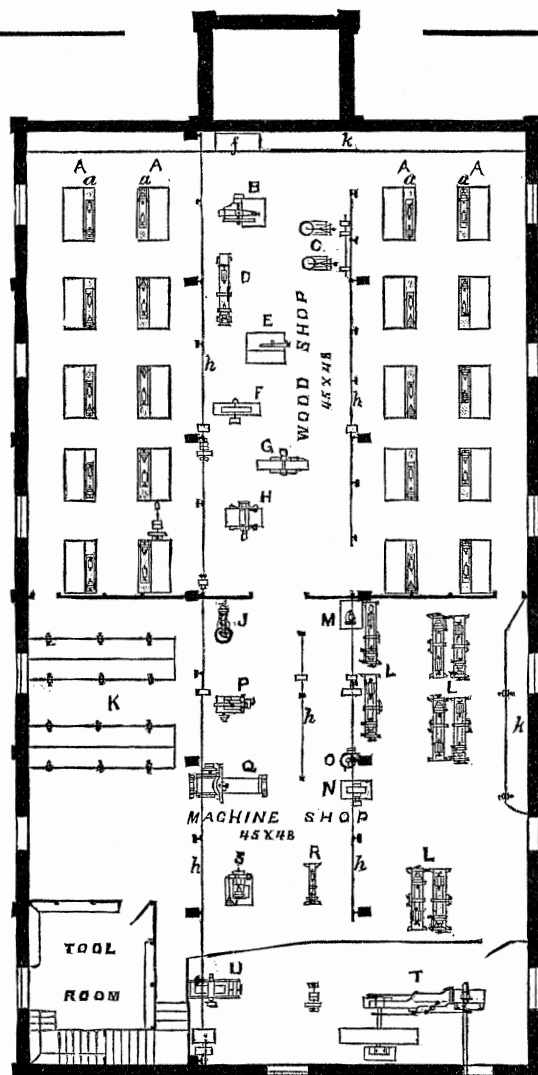
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| A WORKBENCHES | R SPEED LATHE |
| B BAND SAW | S MILLING MACHINE |
| C SCROLL SAW | T ENGINE |
| D PATTERN LATHE | U DYNAMO |
| E CIRCULAR SAW | V MOULDING BENCHES |
| F GRINDSTONE | W CUPOLA |
| G BUZZ-PLANER | X BRASS FURNACE |
| H SURFACE " | Y FORGES |
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any gift of prophecy, nor pretend that the judgment I shall offer upon any of the cases is to be considered infallible; for so complex or obscure are most of these problems, that it is of the utmost importance to recognize not only that much that seems to be truth is mere analogy, but that a large part of what seems to be false is merely paradoxical.

I shall speak chiefly of certain propositions of modern economic writers which are so much at variance with the current doctrines of political economy, that, if true, they are certainly paradoxical; but before coming to them, and as a sort of preparation for them, I will mention a few others of a much broader character, which, assuming their truth, may properly be called social, or sociologic, paradoxes. I have preferred to treat these propositions as paradoxes in analogy to the paradoxes of physical nature to which I have referred, rather than to treat the better-known and generally accepted dicta which are contradictory to them as popular errors or fallacies, because I deem it less important to lay stress on the error contained in the latter than upon the truth contained in the former, and also because this method of treatment possesses a certain novelty which may lend some interest to a subject which at its best will be regarded as dry, even if it be less 'dismal' than the orthodox political economy has acquired the name of being.

Perhaps the broadest of the paradoxes which can be claimed as sociologic, and which certainly applies to the next lower stage of biologic law, and still more obviously to physical phenomena, is embodied in the theorem that *the artificial is superior to the natural*. Certainly this proposition does not seem true, and, on the contrary, seems to contravene all our common instincts and intuitions; but when subjected to careful study or candid thought, its truth is invincible, at least in those more simple periods of action. For even a well-shaped club is superior to the fists, not to speak of bows and arrows and Springfield rifles. So are houses better than caves; and clothing, however coarse, better than nakedness. The same is true for nearly every material thing to which any value is assigned. And in the organic world the vegetable and animal products which have most value are those which have been perfected by human culture, and are, in so far, artificial.

It is therefore only in the higher stage of sociologic phenomena that this proposition admits of being disputed by the candid student. Here some of the highest authorities stoutly maintain that nature is not to be interfered with, with impunity. But the curious part of their case is, that they base it upon the general negation of our original proposition; viz., upon the ground that the natural is superior to the artificial,—the proposition which in physics and biology is clearly false. It is therefore a *petitio principii*.

The sociologic paradox may, then, be put in this form: *the arbitrary control of the social forces is economical*. Or the converse: *the normal action of the social forces is wasteful*. The orthodox economists maintain that the normal action of laws that govern the social and industrial world are not only economical, but are the very best possible, and cannot be interfered with without injury to the interests of society. And the philosophers of the individualist school take the same view of it. They even deny the expediency of sanitary regulation in cities, and maintain that mortality due to bad drainage is a sufficient inducement to individuals who own the property to combine and perfect the drainage. I cite this merely as an example of the absurd lengths to which this favorite theory leads such writers. In the light of the sanitary progress of the nineteenth century, due entirely to organized social effort, such statements can scarcely be supposed to emanate from the sane mind.

Starting from such extremes, it would not be difficult to show that the general doctrine of *laissez faire* is unsound when contemplated as a universal principle of sociology; and so much has lately been said upon this point, that all the best writers, even in England, who still desire to hold on to the doctrine, are giving up its universal applicability, and only contending for it on the ground of expediency. Nothing more could be asked, since no fair-minded person will deny that it is often better to allow the most absolute free play to the natural agencies, not merely of society, but of physical nature as well. But that even free trade may sometimes be a very costly policy is as clear as that manufacturers should be authoritatively forbidden to adulterate drugs and articles of food.

But not to dwell upon such broad principles and generalizations, and coming nearer to the domain of economics and modern questions of social reform, I will, at the risk of some abruptness, state another paradox in the following words: *reforms are chiefly advocated and brought about by those who have no personal interest in them*.

I do not claim that this is universal, and there usually comes a time in the history of every reform when the victims of the evil to be reformed join in the work, and help to secure its consummation. But in some cases, like the abolition of slavery, even this does not take place. And any one who will take the trouble to inquire into the constitution of those assemblies and associations that meet and organize for various charitable, benevolent, and reformatory objects, will find that they are composed almost exclusively of persons who are actuated by purely altruistic motives, and have nothing to gain beyond the approbation of their fellow-creatures. Even great political reforms are usually instigated and chiefly prosecuted by persons not at all interested in their success, except from some high moral point of view. So much is this the case that working-men's parties are usually officered by lawyers, professors in colleges, clergymen, or writers on social topics. I do not deny that these men may often have selfish designs, but I am not misanthropic enough to doubt that their motives are primarily pure and disinterested. Certainly they are not usually men who would be pecuniarily affected by the success or failure of the reform.

But I have introduced this chiefly in order to lay more special stress upon one of its corollaries; viz., *discontent increases with improvement of the social condition*.

No one will deny to this proposition the character of a true social paradox. Certainly the normal mind would naturally reason, that, as the causes for complaint were removed, the discontent would diminish. But the most careful study of the history of civilization has shown that this is not the case. The reason for this, like the reason for all natural truths which are paradoxes when first stated, is clear when the explanation is given. We saw that in the case of slavery the reform must originate with a different class from the victims of the evil. We even hear of slaves who do not want their freedom. But, however much they may want it, they are in no position to advocate emancipation. And it is largely so with the industrial classes who are not slaves in the literal sense of the term. Virtually they are, up to a certain point, either incapable of realizing the need of reform, or powerless to act in the direction of improving their condition. Discontent is proportional to the degree in which the oppressed class realizes its condition, and increases as the hope grows that an improvement can be brought about by complaint or by concerted action. But this stage is not reached until external influences have already wrought an important change for the better: hence the paradox that discontent increases with improvement. It presupposes, however, that real hardship exists, and would not be true where entire justice was done.

The special importance of this law arises from the fact that one of the leading arguments against all attempts at industrial reforms has been that the condition of the laboring-classes is really improving. Mr. Henry George has greatly injured his case in denying this, such denial being implied in the title of his book, 'Progress and Poverty,' and repeatedly enforced throughout the work. Though bad for Mr. George, this course has proved useful in startling both classes, and spurring them on to investigate the facts. Both have now learned the truth, that the condition of the working-classes has improved, and greatly improved, in nearly all civilized countries. The opponents of further labor-reform point to these facts, and declare that there is no ground for complaint, and imagine they have closed the argument. But the wiser among the reformers perceive that it is just this improvement which has rendered discontent possible, and they rightly regard this as demonstrating that the reform is not yet complete, and propose to continue to agitate until the triumph of justice shall in a natural way put an end to all discussion.

I shall consider only one more of these broader sociologic paradoxes. This is embodied in the proposition that *the means of subsistence increases more rapidly than population*.

This, as you all observe, is the exact opposite of the Malthusian

law. The almost universal acceptance of that law is sufficient to stamp this as a paradox, provided it be true. Mr. Henry George was, I believe, the first writer who had the courage to formulate it and attempt its substantiation. In this, I must admit, he has been successful. After reading his argument, one is inclined to wonder how any other view could ever have been taken. Society is really a great co-operative institution, and as such it has succeeded in economizing the forces of production. All who understand what the value of co-operation consists in, know that the more general it is, the more effective. Society, though a very imperfect form of co-operation, is a very general one, and it results, defective as it is, in a greater production *per capita* than could be secured by individuals each working for himself; that is to say, the larger the population of any given community, the greater the amount of subsistence that each can and does produce.

There are two curious facts that result from this, both of which are decidedly paradoxical in their character. One is, that this is the very truth which has been so exultantly brought out by the chief defenders of Malthusianism when they showed that the condition of the disaffected classes is improving. It is improving, and has been improving, with a few interruptions, ever since the beginning of the industrial epoch; but this improvement has been the result of social co-operation, division of labor, employment of machinery and all the other agencies that result from social integration and the increase and massing of population. The more dense the population, the greater the friction of mind upon mind, the more rapid the development of intelligence, the quicker the action of the inventive faculty, and the more exact, methodical, and economical the outlay of energy in the production of wealth. Everybody is familiar with this law in the obvious contrast between intelligence and thrift of city and country population. As Mr. George has well said, the world has never yet reached a point at which the population was too dense to create wealth, not merely in proportion to the subsistence required, but in excess of it. Thus far all experiments which history affords have proved the law above formulated in diametrical antithesis to the so-called 'law of Malthus,' and shown that production increases with population in some ratio greater than unity. The second curious result of this truth so successfully established by Mr. George, is that it serves as a flat contradiction of the fundamental theorem of his book; viz., that poverty increases with wealth. It would, of course, be easy to find isolated cases, perhaps important departments of industry, in which the haphazard development of modern wealth-producing agencies has worked severe temporary hardship; but that they tend, using the old phrase, "to make the rich richer, and the poor poorer," in any permanent or systematic way, may be regarded as apodictically disproved. Coming next more nearly within the field of political economy as that science is usually defined, let us note a paradox which may be regarded as a corollary of the one last considered. It may be stated in this form: *capital is more effective than labor in the production of wealth.*

In the view of the popular belief that labor creates all wealth, this, if true, must certainly rank as a paradox. To understand its truth we must consider what constitutes capital. To do this we must loose entirely from all the current definitions which may, however, also be true, and look at it from one special point of view. It is a common thing to hear it said that in the modern industrial world it is not human power that produces most of the wealth, but natural forces. This is true, and is one way of looking at it. It is equally common to hear it said that it is not muscle, but brain, that accomplishes the principal results. This is also true, and another way of looking at it. Brain, i.e., intelligence, organizes and directs natural forces, and the latter do the work. Still a third point of view is expressed when it is said that it is machinery which does it. Machinery is the material embodiment of intelligent direction of natural forces. But very few, I imagine, have taken the fourth step in this train of reasoning, and attributed the result to capital. Yet this view is perfectly legitimate, and a necessary sequence of logic. The term 'machinery' is too narrow. Much of the force will not admit of being referred to it. The expression 'natural forces' is often not strictly applicable. Animals often supply the motive power. 'Intelligence' is too vague a term to reduce to economic language. But 'capital' includes every possible agency, and it is

really to this that all production beyond what could have resulted from naked human muscle is due. This, I need not tell this society, is the greatest bulk of all that makes up civilization. We thus come back to the paradox with which we started out, of the artificial over the natural.

We will next consider the proposition that *wages are drawn from products, not from capital.*

The old economists all maintain that there was a particular part of capital, called the 'wages fund,' from which all wages were paid, and without which, or beyond which, no wages could, under any circumstances, be paid. Mr. Henry George has shown that there is nothing of the kind; and so clear is his demonstration upon this point, that Professor Clark, in his admirable little work on the philosophy of wealth, pronounces his reasoning as clear as any thing in mathematics. Capital, as we have seen, consists in the machinery, tools, appliances, and other labor-saving agencies, employed to increase production. Money, except when used for these purposes, is not capital. The idea that the manufacturer lays aside a certain sum of money to pay for his labor, which he keeps distinct from his profits, as a wages fund, is sufficiently absurd to need no disproof. What he really does is to count the sum needed to pay his laborers out of his profits as current earnings devoted to production, and it is out of production that this sum must come from week to week or from day to day. For myself, however, I can see no distinction between this and the money devoted to the purchase of tools or machinery. It is capital in the true sense of the term as wealth applied to production.

We are now prepared to consider what I regard as the most important, as it is the least unequivocal, of all economic paradoxes. It may be expressed in the following form: *profits rise with wages, or in the stronger form; increase of wages results in increased profits.*

Surely this proposition would stagger an old-time political-economist; and very few employers, with all their mercantile sagacity reputed to be so unerring, could be brought to accept it. In fact, not only is the exact opposite theory the only one taught in the books, but the business of the whole world has always been conducted upon it, and to the normal mind the statement that profits will diminish as wages increase seems to be self-evident. How, then, can the opposite be maintained? We owe to Mr. George Gunton, the author of a recent work entitled 'Wealth and Progress,' the full elaboration of this new theorem; and any believer in the old one who will carefully read this book, provided he be really seeking the truth, can scarcely fail to admit that there are two sides to the question. For myself, I can scarcely resist the acceptance of the new doctrine, though, of course, with certain qualifications and reservations. It is something like the argument for non-resistance. Any one who understands it must admit its truth; and yet for those who believe it, so long as their number is small, to undertake to apply it, would be ruinous to themselves, and would seem to disprove the doctrine itself.

Mr. Gunton's method of exposition is something like the following: political economy, as expounded in all the books, teaches that industrial society is divided into two great classes, — producers and consumers. In this classification the wage-receivers are uniformly classed as producers. The consumers are a class who go into the market, and purchase the products wrought by the wage-receivers. They are vaguely conceived, illy defined, never distinctly located, and, except that they actually buy the goods and consume them, they are a sort of economic myth. But Mr. Gunton asks, "Who are these consumers? Where are they? What are they?" A consumer is a human being. He is part of the population. Somewhere in the population he is to be found. In fact, the consumers are the whole population. The wage-receivers must therefore also be consumers; and when we take the census of population, we find that they, with their families, constitute the greatest majority. Therefore, in all calculations based upon the nature of the market, not only must they not be ignored, but they must be regarded as the prime factor. But it may be said that they consume much less than the other classes of people. Their humble rank and simple wants make them scanty consumers, and therefore it is necessary to bid for the wealthy classes, and neglect the laboring-classes. No one will claim that they consume as much *per capita* as the

rich, certainly not of certain products. But here, again, Mr. Gunton asks, "Why?" The obvious answer is, "Because they have not the means." But will any one claim that the working-classes consume all they would if they had the means? Surely not. There may be some so low that they could make no use of any thing more than they have, but this is hardly conceivable. With scarcely an exception, they want much which they cannot have because they have not the means to purchase it. But their means consist wholly in their wages. To increase their wages is to supply their wants. This is all they think of. But the employer is apt to look at the question as though all money paid for labor beyond the minimum possible would be hoarded in the cellar and lost to industry. This view, tacitly shared by the economists, is obviously false. What is supplying wants to the laborer is furnishing a market to the manufacturer or the farmer. The vast number of laborers, and the certainty that all increase of wages will be expended and not hoarded, make even the smallest general rise in wages an important stimulus to production. It expands the market for all classes of products. Statistics show that periods of high wages have uniformly been periods of increased production, and increased production means prosperity to the manufacturer; i.e., profits rise as wages rise.

Time fails me to elaborate this important principle as it has been done in Mr. Gunton's book, and I can only recommend those interested to read his argument for themselves. From this, however, as the fundamental theorem, a large number of new and striking truths, most of them in the nature of paradoxes, arise. Only a few of them can be considered here. One of them is that *prices fall as wages rise*. This is maintained by Mr. Gunton, in face of his general law that the price is determined by the cost of production. Surely one would suppose that the cost of production would be greater if the cost of labor were increased. Just here lies the paradox. Doubtless this would be true for an isolated case, but it would not where the rise of wages was on a large scale. The reason is, that, with the increase of wages, the market is increased and production is increased. As the production was at the minimum for existing methods before, the increased production must now be brought about by an improvement in the methods; i.e., by introduction of improved machinery. This always lessens the cost of production; and this, according to the law above stated, will sooner or later compel a reduction in the prices of commodities thus more cheaply produced.

Another of these statements which Mr. Gunton claims to establish by statistics is, that *rents rise with wages*.

One would naturally suppose that rent, as the price paid for lodgings or business-offices, or space to build or work upon, or for agricultural purposes, would follow the law of prices, and fall as wages rose. Mr. George virtually asserted this in maintaining that the rent was taken out of wages, so that the higher the rent the lower the wages. But Mr. Gunton shows, that, as rents have risen, wages have risen; that the highest wages are paid where the highest rents are charged, i.e., in cities; and that the lowest of all wages are received by those who pay no rent, but occupy the soil without let or hindrance. The argument is scarcely fair, and the truth seems to be, that, as wages rise higher, rents will be paid, but better tenements will be occupied; so that the case is on a par with the last, that increase of wages increases consumption, which is seen in better habitations, the same as in better clothes and furniture.

But perhaps the most important of Mr. Gunton's conclusions are those relating to the hours of labor. Two of these may be briefly considered. One of these is that *a reduction of hours tends to increase production*.

This, perhaps, sounds more paradoxical than any of the preceding propositions. Surely one would naturally suppose that there would be more produced in ten hours than in eight. Not so. The laborer remains a consumer the same after as before the reduction. Unless new machinery is introduced, the same amount of labor will be required after the reduction as before: hence a larger number of laborers must be employed. These, in the present condition of society, are always to be had. The number of able-bodied persons constantly seeking or out of employment is equal to one-fifth of the whole. These unemployed persons would at once find employment. While unemployed, the amount consumed by them is at an absolute minimum. As soon as they begin to receive wages, they

begin to consume more, and thus the demand for various kinds of commodities is increased. This demand is sure to be supplied by increased production, which will be secured by the introduction of improved machinery if it cannot be done otherwise.

But this is not the only way in which a reduction of the hours of labor works the increase of production. By affording a little leisure to the workingman, it gives him a taste, or rather an opportunity to indulge taste already possessed, for certain elements of culture and social refinements, which he will then begin to demand, and which will be accordingly supplied by the general law of demand and supply, which supply consists in increased production. But, assuming that all his earnings were previously expended on necessities, this would be impossible, and hence arises a final paradox that *the reduction of hours tends to increase wages*.

But for the foregoing explanations this would be strange enough. Whenever there is a demand for a reduction of hours, it is always met by the reply, that, in the state of business, it can only be granted on condition that wages be correspondingly reduced. And this would doubtless be necessary with many isolated industries, at least at the outset. A reduction of hours is considered equivalent to an increase of wages. But a general reduction of hours, continued long enough to have its natural and final effect upon society and upon industry, will create an increased demand for all classes of commodities requiring the introduction of improved machinery for their production, thus cheapening the cost of production, increasing the profits of the manufacturer, and enabling him to pay higher wages and still enjoy greater profits. This, under free competition, he will be compelled to do, and will do in harmony with the economic laws of society.

Without further argument of these several propositions, I will close this paper with a single comment. If any considerable part of what is claimed is true, it proves in a most conclusive manner what I have so often insisted upon, — that to the power of production there is practically no limit, and that all that is needed to place in the possession of every member of society every object of his most cherished desire is the power to purchase it. Very few indeed are there who possess, or can possess, every purchasable object of desire. The present production of industrial society would not be equal to a tenth, probably not a hundredth, of what would be consumed if every one could supply at will every proper and legitimate want of his nature. It is therefore useless to talk of increasing production except by the increase of the power to consume. This is demand in its true economic sense, — the demand which will be supplied by the natural operation of industrial laws. We have therefore narrowed down the great economic problem to the one single point of how to enable the members of society to secure for an equivalent the objects which they desire to consume. Mr. Gunton has sounded the keynote of the solution of this problem in demanding increased wages and reduced hours of labor for the great consuming class of workingmen, — in popular phrase, the 'toiling millions.' It remains for other economic philosophers to show how this principle can be extended to include all mankind.

ELECTRICAL SCIENCE.

Electric Tramways in Great Britain.

THE paper on the Bessbrook and Newry tramway, read by Dr. Hopkinson before the Institute of Civil Engineers, has brought forward some valuable information as to the status of electric tramways in Great Britain. Last year there were eight tramways operated by electricity in Great Britain. The longest is 6 miles; the shortest, $\frac{3}{4}$ of a mile; the average being $2\frac{3}{4}$ miles. The power for the two shortest of these is from gas; for two of the longest, from water; for the rest, from steam. The electricity is transmitted by rails, — in some cases specially insulated central or side rails, — or accumulators are carried on the cars; the overhead system so generally adopted in this country and in Germany being in no case used.

The Bessbrook and Newry line is $3\frac{1}{4}$ miles long, with an average gradient of 1 in 86, a maximum gradient of 1 in 50. The conditions are, that ten trains run in each direction per day for a daily traffic of 100 tons each way, and a maximum capacity of 200 tons per day, in addition to the passenger traffic. The electrical loco-

motive draws a gross load of 18 tons, in addition to passengers and its own weight, at an average speed of 6 miles per hour : with 12 tons load, its speed is 9 miles per hour.

The generating dynamos are driven from a turbine at about one-third the distance from the Bessbrook end of the line. The weight of the motor-cars is distributed as follows :—

	Tons.	Cwt.	Qrs.
Car body.....	3	6	1
Leading truck.....	1	17	2
Rear ".....	1	0	0
Motor and accessories.....	2	1	1
	8	5	0

The current is conveyed to the car through a central rail insulated on blocks of paraffined wood, returning through the earth and track. The gearing is first from the motor-axle through a spur-gear to a countershaft, then from the countershaft to the car-axle by a chain gearing. The total cost of the line and equipment, including two locomotive cars, was £2,500. The cost of running per train mile has been 4.2 d.

During the discussion, Mr. Lineff brought forward a comparison between the cost of conductors and accumulators for electric traction. He assumes the interest and depreciation of conductors at ten per cent ; of accumulators, at thirty per cent ; representing overhead conductors by A ; underground by B, and batteries by C.

Length of Line.	Two Cars.			Four Cars.			Six Cars.			Eight Cars.			Ten Cars.		
	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.	A.	B.	C.
1 mile	200	1,500	2,400	225	1,525	4,800	250	1,550	7,200	275	1,575	9,600	300	1,600	12,000
2 miles	400	3,000	2,400	450	3,050	4,800	500	3,100	7,200	550	3,150	9,600	600	3,200	12,000
3 "	600	4,500	2,400	675	4,575	4,800	750	4,650	7,200	825	4,725	9,600	900	4,800	12,000
4 "	800	6,000	2,400	900	6,100	4,800	1,000	6,200	7,200	1,100	6,300	9,600	1,200	6,400	12,000

Mr. Lineff assumes that each car needs three sets of storage-cells, 1½ tons in each set, at £60 per ton ; and the cost is increased three times in the table to allow for three times the depreciation as compared with conductors. The increased cost of cars and motors for the accumulators is taken at fifty per cent of their value. In reality there would be required but two sets of cells per car, while the increased cost of each car could hardly be the £135 assumed. The comparison, then, is hardly fair to the accumulators. Instead of the £400 per car assumed, £250 would be a fairer price, the cost of the cells being taken at £60 per ton. As it stands, in a line four miles long the accumulators would be cheaper for five cars or less, as compared with underground conductors, while the overhead wire would cost less than either for any number of cars. If the lower estimate given be assumed, then the cost of underground conductors and accumulators will be the same on a four-mile line when about nine cars are run. Any increase in the length of the line favors the storage-battery : an increase in the number of cars favors the underground conductor. Still in this estimate there is not included any consideration of reliability and flexibility, and in these the storage has many advantages over any other system. It will be seen, however, that the overhead conductor is cheaper than either of the other plans, and in the smaller towns and the suburbs of cities it will probably be generally adopted.

HIGH CANDLE-POWER INCANDESCENT LAMPS. — An English firm, Clark, Chapman, Parsons, & Co., are manufacturing incandescent lamps of candle-powers up to 1,000 candles. They consume about 2 watts per candle, and have a life of 800 hours. It is very possible that the life and efficiency of these lamps will be improved, in which case they will be active competitors with arc-lamps for street-lighting. If the intensity of 1,000 candles is honestly measured, and gives the average of the light in all directions, then the efficiency is about half that of the ordinary arc-lamp. The price of the incandescent lamps is not given ; but we may suppose that the cost of renewal will not be much in excess of that of the carbons used in the arc-lamps, while the attendance will cost little or nothing. The lamps would seem to have a wide field for applica-

tion in buildings where a high candle-power is desired, and where the irregularities of arc-lamps are objectionable. The voltage used is 100 ; the ampères, 20.

THE GIBSON STORAGE-BATTERY. — In this cell the plates are made by fixing peroxide of lead in perforations in a lead plate. In the ordinary 'grid' form of storage-battery plate the holes are of an hour-glass form, — smallest in the middle, — the contraction preventing the plug of active material from falling out. This has the disadvantage that the pressure caused by the gradual corrosion of the grid has a tendency to break the plug in the middle and force it out. To remedy this, M. Godot invented a plate in which the hole was largest in the middle, and smallest at the surface. The objection to M. Godot's plate is in difficulty and cost of manufacture. In the Gibson form the holes go square through the plate : in them are put capsules of peroxide of lead in the form of a paste. The capsules only fit loosely in the holes, and extend beyond the surface. Plates thus prepared are passed between rollers set at such a distance apart that they press the capsules to the level of the surface of the plate, at the same time flattening the lead slightly, and causing the edges to overlap the holes, thus keeping the active material in. The method seems a decided improvement over that of M. Godot to accomplish the same purpose : very possibly, if tried with the best possible form of plate, it will be an improvement

on the ordinary 'grid' type. It hardly seems probable, however, that it will improve either the efficiency of the battery or storage capacity, although it might increase the rate of discharge and the life of the plate.

MAGNESIUM IN PRIMARY BATTERIES. — M. Hein has been investigating the value of magnesium as a positive element in primary batteries. The electro-motive forces are high as compared with results ordinarily obtained ; but there are the objections that magnesium is expensive (it is worth from a dollar and a half to two dollars a pound), and the resistance of the solutions of magnesium salts is greater than that of the ordinary solutions used.

Positive Element.	Solution.	Negative Element.	Solution.	Electro-motive Force.
Magnesium	Dilute sulphuric acid	Zinc	Dilute sulphuric acid	.876
"	" " "	Copper	Sulphate of copper	2.03
"	Sulphate of magnesium	"	" " "	1.93
Magnesium	Dilute sulphuric acid	Carbon	Dilute nitric acid	2.888
"	Sulphate of magnesium	"	" " "	2.863
"	Chloride of magnesium	"	" " "	2.910
Magnesium	Bichromate solution	Carbon	Bichromate solution.	2.952
"	Dilute sulphuric acid	"	" "	2.980
"	Sulphate of magnesium	"	" "	2.901
"	Chloride of magnesium	"	" "	2.970
Magnesium	Chloride of ammonia	Carbon and manganese dioxide.		2.219
"	Chloride of magnesium	"		2.334

MENTAL SCIENCE.

Psychic Disturbances in Russia.

THE subjection to law, of phenomena apparently the result of free individual choice, forms one of the most interesting results of the application of scientific methods to the observation of mental facts. Statistics have made us so familiar with this type of facts, that we are apt to overlook their real significance. The number of suicides, to take one instance of many, we know to be quite constant (in the absence of unusual causes) from one year to another, and yet we usually regard this act as the result of a voluntary deliberation. The various classes of crimes are subject to a similar regularity; and one writer has gone so far as to say that a criminal is as much a manufactured product as is calico, only the methods of production are not so well understood in the former as in the latter case. When any marked deviation in the regularity of such phenomena presents itself, we at once look about for some definite cause, and from a consideration of such causes we are enabled to predict, or at least to confidently expect, that with the presence of such unusual causes there will be found unusual deviations in the prevalence of the phenomena that depend upon it. Thus M. De Candolle, from a study of the frequency of eminent *savants* in various countries, tabulates a series of influences that foster the development of science as well as of those that hinder its growth, and is even able to ascribe a relative importance to these influences. A very striking illustration of the intimate relation between two such series of facts is to be found in an article by N. Tsakni (*Contemporary Review*, March, 1888), upon 'Mystical Pessimism in Russia.' The debasing social, political, and educational conditions that exist in that country have been compared to those of the middle ages, as well as to the times preceding the French revolution. The psychic pestilences that devastated mediæval Europe, the host of absurd and fanatic extravagances that took possession of France in the last century, seem to the psychologist to follow as necessarily from the low mentality and unnatural mode of living of the people as does insanity from a disordered brain. It is not surprising, then, to find in Russia a fertile soil for all kinds of superstitious and abnormal growths.

"Pessimism," in the words of the writer whose article we are to follow, "is a characteristic feature of all those epochs of history in which the mass of human suffering is at a maximum, and moral aspirations are entirely out of harmony with social conditions. Involved in an unequal conflict with their surroundings, men come to regard life as a terrible burden, and seek refuge in suicide, or in strange, mystical, and extravagant theories of society." This is the condition of Russia to-day, and as a consequence it is overrun by a series of barbaric occurrences which it is hard to believe are going on in our day. Spiritualism flourishes, and is constantly on the increase: all sorts of religious sects flourish among the well-to-do as well as among the peasantry. Faith in sorcery and the supernatural is everywhere current: a large number of persons earn a living by predicting fortunes and reading the future from the palm of the hand. A simple peasant woman had such a reputation in this regard, that not only the peasants, but even the officials, always consulted her before any serious undertaking. A belief in the evil eye and a host of superstitious cures is wide-spread. Recently a retired officer acquired a reputation for removing hysteria by exorcism; and the leisure classes flocked to this pretender, who repeated cabalistic formulæ as a cure for insanity, paralysis, and inebriety. The small intelligent population is merely an oasis in the vast desert of the population, ignorant, superstitious, and unhappy. Hysterical outbreaks are frequent, and men and women scream like madmen, fall into convulsions, and announce the end of the world. Sects are formed to preach the misery of life, and death as the sole road to salvation.

About twenty years ago a peasant in the province of Perm, after spending much time in the reading of religious books, concluded that the end of the world was at hand, and converted his neighbors to his belief. Voluntary suicide was the only release from the misery that surrounded them. A number of men, women, and children, including the members of his own family, retired to a forest, where the men dug catacombs, while the women made shrouds. This lasted three days. Then all the disciples, dressed in the garments of

death, three times renounced Satan. The leader gave the command, "Take no food and no drink for twelve days, and you shall enter the kingdom of heaven." Then the days of suffering began. A few, more human than the rest, appealed in behalf of the children, whom they saw writhing in agony, and sucking blades of grass or eating sand; but the leader was immovable. At length two of the fanatics could endure it no longer, and fled. This frightened the band, and the leader announced that the hour of death had come. They massacred the children, and decided to continue the fast. At this stage the police had sought them out, but their frenzy was kindled to the highest pitch. With the prospect of capture before them, a horrible carnage ensued. They killed the women with hatchets, and the efforts of the police only succeeded in saving the leader and three of his associates.

Another instance is that of the monk Falaré, who, not many years ago, went along the banks of the Volga, preaching suicide with great success. One night eighty-four persons met in a cavern that had been filled with straw. They began to fast and pray; but one woman fled, and informed the police. As their pursuers appeared, they set fire to the straw, and threw themselves upon it, killing themselves with hatchets. Many were saved, however, and one of the condemned escaped from prison, and continued to propagate the doctrine. More than sixty persons, including whole families, became his disciples. A day was fixed upon which one peasant went to the houses of the others, killing men, women, and children, all calmly submitting to their fate. The leader then had himself killed. Thirty-five persons, in all, thus perished. These *en masse* massacres are becoming more rare, but all kinds of crimes are still perpetrated as the result of a religious fanaticism. In 1870 a woman threw her child into the fire in obedience to a divine command, and showed no signs of remorse when called to trial. A dozen years ago a man crucified himself, actually nailing his feet and one hand to a cross, and then impaling the other on a nail.

Sects with less horrible practices are numerous. One such calls itself the 'Negators,' and its members keep themselves aloof from all men. They recognize no government, no right, no duty, no property, no marriage, no rites of any kind. Each stands for himself, and life is of no value. They oppose compulsory labor, and neither hire themselves as nor keep servants. They lead lawless lives, and spend much of their time in prison. About twenty-five years ago the 'Jumper' (Prigoony) appeared. They found many followers in the Caucasus and the neighboring mountains, where prisoners had been exiled. The chief apostle of the sect called himself God, and among their doctrines was the gaining of insight by prayer and ecstasy. The face would grow pale, the breath be quickened; then the body would sway, the feet begin to beat, followed by jumping and violent contortions, until exhaustion ensued. Some cry and declare the Spirit is upon them. The meeting ends by a fraternal kiss among all the members, men and women. They abstain from many kinds of food, allow no stimulants, and forbid all even the most innocent pleasure. Their time is spent in praying and fasting, but they have no ceremonies of any kind. A group of these calls itself the 'Children of Zion.' They live in solitary houses, and scourge themselves, jumping and shrieking until they are possessed. They fast, often letting their women and children die of hunger. They believe the end of the world to be near, and regard themselves, as do other sects, as the only true Christians. They predict a kingdom of Zion that shall last for a thousand years. Their leader has twelve apostles and a number of queens. When once displeased, he threatened to fly to heaven. Another sect are the 'Communists,' who regard themselves as the elect people of God. They, too, have ecstasies, and predict the end of the world. A man of twenty-five and a girl of eighteen represent Christ and the Virgin among them, and receive homage. They preach an equal ownership in property, and a rich citizen gave up his property to be divided among them. The police has interfered with the organization, but it is still secretly propagated. These are only samples of the many social and religious disturbances that give evidence of the abnormal state of mind under which these unfortunate people live.

ILLUSIONS OF SIGHT AND MOTION. — The senses are subject to illusions in proportion to the remoteness of the information that

they give from the immediate necessities of the organism. Touch, the most immediate and least inferential of the senses, is least subject to illusions; while sight is so very much so, that the blind often say they have an advantage over the seeing in being free from visual illusions. The illusions of bodily motion are much nearer to those of touch than to those of sight, and yet they can under certain conditions be induced through visual impressions. Of this the writer has recently had two interesting examples. He was standing upon the floor of a railroad-depot, the boards of which were laid with a considerable open space between them; and the shadow of an electric light was moving up and down by the swinging of the light in the wind. Looking at the floor, it seemed as though the shadow were stationary, and the floor-boards moving. From this it followed that the person on it was moving too, and the writer distinctly felt the swinging sensation: in fact, his attention was called to the phenomena by this feeling of motion. The other observation was as follows: while riding in the cars and looking out of the window, the trees and all are seen to move in the opposite direction. If, now, one looks in a mirror so situated that it reflects the passing landscape, which, however, must not be visible except in the mirror, one has the illusion of moving in the opposite to the real direction of motion, owing to the reversal of the image in the glass. In both these cases an immediate bodily sensation is induced by a more or less unconscious inference through visual sensations.

HEALTH MATTERS.

Scarlet-Fever.

ONE of the most valuable communications which we have received in answer to the series of questions which were propounded relative to scarlet-fever in *Science* of Dec. 16, 1887, is that from the pen of Dr. Henry B. Baker, secretary of the State Board of Health of Michigan. The arrangements which Dr. Baker has instituted for obtaining information from every town and village of the State are so thorough and complete, that the deductions made from the statistics thus obtained are especially valuable and trustworthy.

Dr. Baker does not believe that scarlet-fever ever arises *de novo*, but, judging from researches by Dr. Klein and others, thinks it is possible that the pre-existing case may have been a cow or some other animal, and not a human being. There is no doubt in his mind that scarlet-fever is a communicable disease; and he gives the following instances which have come under his own personal observation, tending to prove this communicability:—

(a) A child about four years old was taken sick with scarlet-fever a few days after putting on a cloak made in a room in which was a little girl convalescent from scarlet-fever.

(b) A young woman came into the (small) residence in which a child was sick with scarlet-fever, remained less than an hour, rode several miles into the country, where in a few days she was taken sick with scarlet-fever.

(c) Members of the family into which was introduced the young woman mentioned above, in a few days were taken sick with scarlet-fever, and one of them died.

In reference to the communication of bovine scarlet-fever to man, either by contagion or the milk of affected animals, he has no information except that which has already been given relating to the Hendon dairy, of which he says that the evidence of scarlet-fever being communicated from diseased milch-cows is given by Mr. Power and Dr. Klein, who traced outbreaks of scarlet-fever to milk received from diseased cows on the Hendon farm in England. Milk from these cows was distributed by all the distributors of milk from the Hendon farm except one, and this was the only district supplied by milk from this farm which was not affected with scarlet-fever. Dr. Klein obtained from these cows a particular microbe identical with the micrococcus found in persons affected with scarlet-fever. Other cows inoculated with the micrococcus from scarlet-fever patients became affected with a cutaneous and visceral disease similar to that which affected the Hendon cows. We have already (*Science*, Feb. 10, 1888) referred to the fact that these observations of Power and Klein are disputed by Professor Crookshank, who investigated the matter for the English privy council.

Crookshank believes that the disease was cow-pox, and not scarlet-fever, and that, as a natural sequence, the outbreak of scarlet-fever attributed by Klein to the Hendon cows had no connection with them whatever. In Dr. Baker's opinion, a person who has had scarlet-fever is probably liable to communicate the disease to others until after the completion of the process of desquamation (peeling or scaling of the outer skin), which process also occurs to surfaces in the interior of the body, and which, on some external parts, *may* not be completed for two or three months. But without bathing, and change of clothing or its thorough disinfection, a person may communicate scarlet-fever many months after desquamation has ceased. Cases illustrative of this are recorded on p. 257 of the 'Report of the Michigan State Board of Health for 1885,' p. 275 of the report for 1884, and p. 219 of the report for 1886.

Dr. Baker has personally known of instances where articles of clothing, books, etc., have retained infection for a few weeks; but he has known, by means of reliable information, of the infection having been retained for much longer times. For instance, a trustworthy physician informed him that a patient of his, being cold, went to a closet and procured a cape worn by his brother one year before, during convalescence from scarlet-fever. In a few days he was himself taken sick with scarlet-fever. Dr. Baker thinks that boards of health should not require reports of cases of scarlet-fever to be made to them unless the people themselves have by law made provision therefor. Nothing is gained by boards of health, or other servants of the people, attempting to dogmatically force people to do what their intelligence, or lack of it, does not lead them to see is right and just. Boards of health should strive to put the facts before the people, and to execute existing laws.

The *people* should by law require that prompt report be given to the local health-officer, on the occurrence of a case of scarlet-fever. Proper penalty should be affixed to the violation of this law, and the law should be enforced by the prosecuting attorney. The report should be required to be made by every householder, hotel-keeper, keeper of a boarding house, or tenant, who shall know, or shall be informed by a physician, or shall have reason to believe, that any person in his family, hotel, boarding-house, or premises is taken sick with scarlet-fever. The notice should state the name of the person sick, and so designate the house or room in which the person is as to enable the health-officer to enter at once upon his duties of restricting the disease as promptly as the fire department enters upon the restriction of a fire. The penalty should not be enforced against a householder, etc., if the case is at once properly reported by the physician. Every physician should be required to report to the local health-officer every case of scarlet-fever which comes under his observation. A fee should be paid by the people to the physician who makes such a report for the public good.

The reasons why notice of scarlet-fever should be given are similar to those why public notice of a fire should be promptly given by whoever gains the knowledge first. The common safety of life is endangered by keeping such knowledge secret. No one person's or few persons' interests should be permitted to weigh against the interest of humanity at large.

If the law permits, it is the duty of the board of health to act as promptly for the restriction of the disease as the fire department acts for the restriction of a fire, and for similar reasons: life and property are in jeopardy so long as the case is not isolated.

The law should require the health officer¹ (a) immediately to investigate the subject, and, in behalf of the board of health of which he is an executive officer, (b) to order the prompt and thorough isolation of those sick or infected with such disease, so long as there is danger of their communicating the disease to other persons; (c) to see that no person suffers for lack of nurses or other necessities because of isolation for the public good; (d) to give public notice of infected places by placard on the premises, and otherwise if necessary; (e) to promptly notify teachers or superintendents of schools concerning families in which are contagious diseases; (f) to supervise funerals of persons dead from scarlet-fever; (g) to disinfect rooms, clothing, and premises, and all articles likely to be infected, before allowing their use by persons other than those in isolation; (h) to keep the president of his

¹ In cities so large that this work cannot be done by the health-officer, a sufficient number of experts should be employed in this work.

own board of health, and the secretary of the State board of health, constantly informed respecting every outbreak of scarlet-fever, and of the facts, so far as the same shall come to his knowledge, respecting sources of danger of any such diseased person or infected article being brought into or taken out of the township, city, or village of which he is the health-officer.

The spread of scarlet-fever can generally be prevented by the plan of prompt notification, thorough isolation, and complete disinfection of all infected substances. But when this plan has come into general operation, there is needed a plan for the prevention of the introduction of the disease from without the jurisdiction. Quarantine officers should be required to be as watchful and strict to prevent the introduction of scarlet-fever as of small-pox, because the loss of life by scarlet-fever is many times greater than by small-pox. For results of perfect and of imperfect compliance with this plan, see the diagram (A) presented herewith; see also Proceedings of Michigan State Board of Health, January, 1887, where it is shown that there was a probable saving of 3,718 lives from this one disease in the first eleven years after the adoption of this plan by the Michigan State Board of Health.

Probably much may be done to prevent well persons from contracting scarlet-fever when they are exposed to it. Statistics seem to prove that the rise and fall of this disease are controlled by the temperature and humidity of the atmosphere; scarlet-fever rising after the temperature falls, and falling after it rises. The reasons why are stated in Dr. Baker's paper on 'Some of the Cold Weather Communicable Diseases' (with diagrams), in the Transactions of the Michigan State Medical Society, 1887.

A very great number of reports have been received by the Michigan State Board of Health from reliable physicians, stating facts which show that scarlet-fever is conveyed by "direct communication," "exposure while visiting," etc.

The following statements are taken from the reports of the health-officers to the Michigan State Board of Health, showing that scarlet-fever may be conveyed by clothing, etc., and after a long period of time has elapsed since the first case occurred (with the name of health-officer and locality subjoined):—

"A man living in Detroit who has a child living in this neighborhood came to see her, and in a short time the little girl was sick of scarlet-fever. It was ascertained that he had been living with a family who were afflicted with the same."—Dr. S. HOLCOMB, health-officer, Southfield Township, Oakland County.

"By the presentation of the dress of a little girl who died at Jackson to a little girl living here."—Dr. SAMUEL DUBOISE, Unadilla Township, Livingston County.

"A woman brought the disease from Canada in her clothing, and gave it to the children where she staid. Case No. 1 took it then, and case No. 2 took it from the children at school."—E. F. WOOD, health-officer, Isabella Township, Isabella County.

"The only source of contagium that I have been able to discover was through letters received from a family residing in Mount Pleasant, which was then affected with it."—Dr. J. P. COOPER, health-officer, Ithaca Township, Gratiot County.

"I have but one case of contagious disease to report this week, that of Miss N. F., age seven years. The source of contagium is peculiar. Miss G. H., of Grass Lake, Jackson County, Mich., sick with scarlet-fever, wrote a letter to the mother of this patient, and she (the little girl) had the envelope in her mouth. Seven days later she came down with the disease. It seems certain that she contracted the disease in that manner, as there is no other way that I can account for the appearance of the disease in that part of the township."—Dr. H. C. MAYNARD, health-officer, Hartford Village, Van Buren County.

"Last June one of Mr. More's children had scarlet-fever. Strange to relate, but one of them had it. The 10th of this month [November] the carpets were taken up, and Fannie, and Lulu, a cousin living near by, romped and played on them while in the yard. In a little over a week both of them were taken sick with scarlet-fever. No precautions were taken after the case had occurred last June, and hence the outbreak nearly four months afterwards."—Dr. M. E. BISHOP, health-officer, South Haven Village, Van Buren County.

The 'Report of the Michigan State Board of Health for 1884'

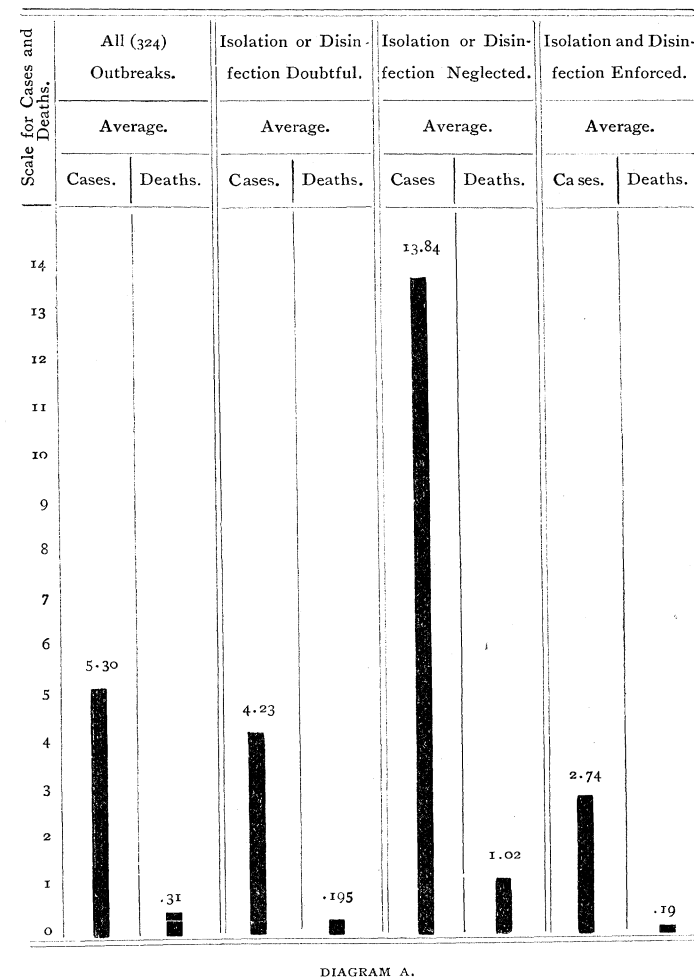
contains, on p. 276, the following accounts of methods of spread of scarlet-fever:—

Dr. A. L. Ambrose, health-officer of Hanover Township, Jackson County, reported three cases of scarlet-fever where the source of contagium was a washtub which had been used several weeks previously by a family having the scarlet-fever. In four cases the contagium was left in houses that had not been properly disinfected. In one case the germs of the disease remained in the bedding that had been used by a scarlet-fever patient six or seven months previously. In one case the disease was taken from "old rags of eighteen to twenty months' standing."

Nov. 19, Dr. N. W. Andrews, health-officer of North Muskegon, writes, "There was, some six or eight months ago, a mild case of scarlet-fever in the adjoining house: at the time, the people who now have the case had some household furniture stored there, which has lately been moved into their own house. I can find no other cause for the outbreak than that the contagium was communicated by means of the tapestry, which had been stored in a room where the child when sick had been allowed to go."

The following interesting statements are extracts from a letter received Aug. 23, 1884, from Rev. Fayette Hurd of Grand Blanc, Mich., giving facts concerning scarlet-fever near the village of Laingsburg, Shiawassee County, during the month of December, 1880:—

"About Dec. 20, 1880, the family were in the garret of the house, gathering up rubbish that had been collecting there for some time. They put into a basket to be burned a number of magazines, pic-



tures, pieces of cloth, window-curtains, carpet-rags, and an old rubber doll, which belonged to a family that had the scarlet-fever in the same house during the winter of 1874-75. The boys gathered up a good many of the pictures, and the girl took the doll, which belonged to the child who had the disease in 1874, and was, I think, used by her when sick with scarlet-fever. The curtains were hung in the windows of the room during the sickness in 1874-75.

The things saved out were used by the children for two or three days. The rest of the rubbish was burned. Near the last of December the three children were taken sick with scarlet-fever."

The diagram (A) exhibits in a condensed form the experiences of the health-officers in Michigan relating to scarlet-fever during the year 1886. It shows, that, in the 324 outbreaks, the average number of cases was 5.30, and the deaths were .31; that in the 45 outbreaks in which isolation or disinfection, or both, were neglected, the average number of cases was 13.84, and the deaths 1.02; that in the 58 outbreaks in which isolation and disinfection were both enforced, the average number of cases was only 2.74, and the average number of deaths .19, the difference being an average of 11.10, and .83 deaths, indicating a saving in these 58 outbreaks of 644 cases and 48 deaths. This saving is shown not simply by comparison with those outbreaks in which nothing was done, but also with outbreaks in which either isolation or disinfection was enforced.

A table (compiled in the office of the secretary of the State board of health, from reports made by local health-officers) giving the basis for the diagram and foregoing statement is as follows:—

SCARLET-FEVER IN MICHIGAN IN 1886.

(1) All Outbreaks. (324 Outbreaks.)		(2) Isolation or Disinfection not mentioned, or Statements Doubtful. (220 Outbreaks.)		(3) Isolation or Disinfection, or Both, Neglected. (45 Outbreaks.)		(4) Isolation and Disinfection Both Enforced. (59 Outbreaks.)		
Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	
Totals...	1,716	100	914	41	623	46	179	13
Averages.	5.30	0.31	4.15	0.19	13.84	1.02	3.03	0.22

BOOK-REVIEWS.

Geology, Chemical, Physical, and Stratigraphical. Vol. II. By JOSEPH PRESTWICH. Oxford, Clarendon Pr. 8°.

THE present volume of Prestwich's 'Geology' treats of stratigraphy and physical geology, — the history of the earth as traced from the study of strata and fossils. In the first volume of this great work, which appeared in 1886, the composition of rocks, and the changes brought about in them by the various meteorological agencies on the surface, and by thermal and chemical action at depths, were discussed, and the nature of the disturbances which the rocks have undergone by the action of subterranean agencies, the elevation of mountain-chains, and the manner of volcanic action, were described. This discussion of dynamic geology is now followed by a geological history. As the handbook is mainly intended for use in Europe, the geological history of Europe, more especially that of Great Britain, is treated more fully than that of other countries; but the author, after having described the geological history of a period in Great Britain, gives a sketch of the contemporaneous course of events in other parts of the world.

The volume deals naturally with two classes of geological data, — paleontological and physiographical. The description of the evolution of life in the various periods and areas is profusely illustrated by carefully selected illustrations, part of which are printed in the text, while others are shown on lithographed plates. The cuts show the characteristic classes and orders which are peculiar to the greater divisions, while the plates show characteristic genera of each group. In discussing the lesser divisions of formations, figures representing important species are inserted in the text. By this arrangement of illustrations, and by a careful choice of the best among the available material, the author has succeeded in making the volume very instructive and useful to the student. He dwells at some length on the results of recent discoveries, and on the important part played by sponges and foraminifera in building up certain sedimentary strata. The relation of the globigerina ooze of the deep seas to the chalk is fully discussed; and the author shows

that the physical conditions of the deep sea of the present time, with its cold polar water, and those of the cretaceous sea, which was probably not so deep, and certainly not so cold, were so different that their deposits must necessarily be different. He compares the chemical and physical composition of the chalks to that of the globigerina ooze, and shows that the former is far purer than the latter, and that no equivalent deposit is forming at the present time. "The conditions under which it was deposited were peculiar and special; and, though it presents many points of analogy to the calcareous ooze, there are none of identity; and the chalk stands alone among the British strata in its peculiar structure and origin. It is for these reasons that I have taken the opportunity of making the foregoing remarks, not because the chalk forms an exception to the general rule of constant change, but because its features are so clear and so well marked that it serves better than most other deposits to illustrate this law of unceasing variation."

The range of genera and species of the same period through space is also briefly described. The geophysical problems which geological history has to treat are wisely confined to the concluding chapters, where the student will find the most important theories held by physicists discussed, so far as they can be proved or refuted by geological data. The author himself advocates the theory of a thin crust, a solid nucleus, and a viscous magma between the two, as he believes that the motions of the earth's crust can only be explained by such a theory.

The volume has a very full index, and is accompanied by a geological map of Europe compiled by William Topley and T. G. Goodchild. The colors adopted resemble, for the most part, those proposed by the International Geological Congress, with the exception of the Trias, Permian, and Siluro-Cambrian, for which the tints more familiar to English geologists were retained.

NOTES AND NEWS.

ABOUT one hundred and fifty scientific men and women of Washington gathered in the hall of the Columbian University on the evening of Thursday, April 5, to pay their tributes to the memory of Dr. Asa Gray, the eminent botanist, and to listen to addresses by several of his intimate friends and co-workers. The president of the meeting was Professor Langley, secretary of the Smithsonian Institution, who opened the exercises with a brief tribute to the memory of Dr. Gray. Professor Chickering delivered the first address, giving a sketch of the life and life-work of Dr. Gray, tracing the gradual unfolding from the pioneer's life of boyhood to the finished scholar and true scientist of middle and later life. The world is indebted to him, he said, for popularizing botany. He put into plain English that which interested people. He had a genius for work. Work was a delight. He was never in a hurry. He had time for social enjoyment with his friends, as well as for investigation and the preparation of a great number of books. He conducted a very large correspondence, but he economized time and labor even in this. He often returned a letter containing a great number of questions with simply 'yes' or 'no' written at the bottom of each. Professor Chickering also spoke of the honors that had been heaped upon him. He was a member of the Royal Society of London, and, of the Institute of France, one of the eight immortal foreign members. Professor Chickering spoke of the last year of his life as the happiest, and closed with an eloquent tribute to his memory. Dr. Vasey of the Agricultural Department spoke of the influence Dr. Gray exerted upon botanical science. He began with a review of the state of botanical knowledge before his time, spoke of his studies under Dr. Torrey in New York, of his botanical text-books, and of his investigations of the collections made by the government and by private individuals. He spoke in detail of his work; said that during his lifetime the number of known botanical species upon the continent of North America had increased from 4,081 to more than 11,000, and the number of volumes of his school-books published was more than half a million. Prof. L. F. Ward of the National Museum spoke of Dr. Gray's relations to the discovery of the theory of evolution, showing that Mr. Darwin had the greatest confidence in him, and intrusted to him, almost before he did to any other, the secret of his great discovery. Dr. Gray was one of the first to understand and appreciate the importance of Mr. Darwin's work, and did more than any other to make it acceptable

to American thinkers. Professor Ward's address, like every thing that he writes, was very compact, and showed an intimate acquaintance with the history of the struggle of the doctrine of evolution for recognition in this country, and of the honorable part Dr. Gray took in it. Dr. C. V. Riley, who was the last speaker, dealt with Dr. Gray as a man. His address was an eloquent tribute to the memory of one of the most delightful men he had ever known, and its interest was heightened by the relation of circumstances connected with Dr. Gray's visit to Europe last summer. Especially touching was his description of Dr. Gray's reception in the meeting of the British Association for the Advancement of Science. Dr. Gray, who was one of the regents of the Smithsonian Institution, had many very close friends among the scientific men of Washington, who mourn him more as a father or a brother than as a fellow-worker in the field of science.

— Captain van Gèle has at last succeeded in solving the problem of the Welle. A telegram sent by Mr. Janssen, governor of the Kongo Free State, on March 15, and published in the *Mouvement géographique*, announces that the Obangi above the rapids of Zongo flows from east to west between 4° and 5° north latitude. Captain van Gèle ascended the river as far as 22° east of Greenwich, and ascertained its identity with the Welle-Makua of Schweinfurth and Junker. Captain van Gèle, after thus having solved the much-discussed problem of the Welle, returned, and reached Leopoldville in safety. It will be remembered that Captain van Gèle, after Junker's discoveries had become known, was put in charge of the exploration of the Welle. On his first expedition, which was made at the high-water season, he was unable to pass the rapids of Zongo. Later on, he made an attempt to reach Junker's Ali-Kobbo from the Itimbiri; but, on account of scarcity of supplies and the density of the woods, he was unable to carry out his plan. On Oct. 2, 1887, he started on his last expedition on the 'En Avant.' After a brief stay at Kwa-mouth, he began his ascent of the Obangi, accompanied by Lieutenants Liénart and Dhanis and a small detachment of soldiers. Junker's farthest point west on the Welle was 22° 55' east from Greenwich. It would seem, therefore, that Captain van Gèle approached this point to within a distance of about sixty miles. The *Mouvement géographique* announces, besides the death of Captain vande Velde, chief of the military expedition to Stanley Falls,—not the explorer of the Obangi, as was erroneously stated in *Science* of March 30,—that of Lieutenant Warlomont, second in command at Boma. This is a serious loss for the Kongo Free State, which had of late been very fortunate, so far as the health of its employees was concerned.

— In a review of Chamberlain's 'Catalogue of Canadian Birds,' it was said that the addition of a systematic table would have greatly enhanced the value of the work. This table has been published by the author under the title 'A Systematic Table of Canadian Birds' (St. John, N.B., published for the author). The table, which contains 551 species belonging to 236 genera, 55 families, and 15 orders, is very clear, presenting at once a table of the higher groups, and a check-list of the birds that are found within the boundaries of the Dominion. Students of American ornithology will be glad to read the author's announcement in the preface, that his promised 'Bibliography of Canadian Ornithology' is well under way, and will probably be published during the coming summer.

LETTERS TO THE EDITOR.

Volapuk : Is it Difficult ?

HERE is a subject pronounced difficult to learn ; yet the learners are unaware of the difficulty. Is not this an anomaly ? It is like the considerate Irish father who proposed to surprise his son with a birthday gift by having him taught the violin 'unbeknownst.' Professor March and Mr. Melville Bell, to whom the learning of strange tongues is a mere pastime, pronounce Volapük too highly inflected, not for themselves, but for the English-speaking masses. But the American business-man, snatching an hour or two in the evenings, somehow or other manages to surmount the obstacle which the professors declare insurmountable, and after a week writes grammatical Volapük. Possibly, had he known that such high authority had declared the feat impossible, he would, with his

well-known modesty, have refrained from a practical contradiction of their dicta.

But do not these philologists (both of whom I greatly admire and respect) unconsciously exaggerate the difficulty of inflected language ? Is it not simply that the inflected languages which they learned as boys, and which they have seen other boys toiling over ever since, had got into a state of anomaly and chaotic irregularity ? It seems to me, from what I have learned by reading the works of these and other eminent philologists, that the crushing-off of terminations which finally happens, is a protest against their lawlessness. I say this with deference and in quotation-marks. Is it not a fact that terminations, when regular, are retained, not destroyed ? There is no indication that we or the Spaniards are likely to drop the convenient and nearly regular plural-sign *s*, and denote plurality by a separate word or not at all. We have, it is true, lost a great many terminations *-en*, and the Germans are doing the same in speech ; but that is of a converse kind of irregularity. Instead of many forms for one thing, *-en* had too many functions : it died of overwork.

Mr. Bell thinks we "may safely assume that the universal language to be some time adopted will express all verbal relations by separate words, and not by root-inflections." Then Chinese is the type of the coming language. Are its methods easy even in the colloquial tongue ? Missionaries say not : I do not know.

Mr. Bell's transformation would result in this, for example, retaining the Volapük syllables : to express 'of the man,' 'of the time,' 'of the form,' 'of the staff,' 'of the stone,' where we now say *mana*, *tima*, *foma*, *stafa*, *stona*, the new reading would be *a man*, *a tim*, *a fom*, *a staf*, *a ston*. *Tima*, in one word, comes under the head of 'Case-Endings and Other Grammatical Subtleties : ' *a tim*, in two words, is simple, and devoid of subtlety. What a wonderful change is wrought by the printer's space !

I could sincerely wish, with Mr. Bell, that there were an alphabet in use, not only for Volapük, but for all languages, which should be "easily and uniformly intelligible to all readers." Mr. Bell's marvelously perfect alphabet, 'Visible Speech,' would answer the description ; but it would have been folly to use it for Volapük until adopted for national languages. The Roman alphabet is the international alphabet at present, and Schleyer acted wisely in keeping it. In so far as he deviated from it by his use of the un-Roman *ä*, *ö*, *ü*, and his un-Roman sounds of some consonants, in so far he is at fault. His principle was right. It is the associations of our barbarous English spelling which make us mispronounce new words like Volapük. If the English *o* had not double duty to perform, we should unerringly begin the word like '*vocal*,' not like '*volume*.' Some of us spelling-reformers hope some day to restrict *o* to its proper function.

Bishop Wilkins's 'Real Character' (by which he does *not* mean 'phonetic representation'), and scores of other attempts at philosophical language based on classification of ideas, have failed (in spite of the genius of at least the first named) to come into practical use. Volapük has been learned by more persons, I believe, and more used in printing and writing, than all the others put together. There must be a reason for this, which I call upon the theoretical objectors to explain. An imperfect mechanism which actually works is better than a most scientific motor which 'motes' not.

In counting up the words which are like their English prototypes, Mr. Bell has omitted such as these : *tim* (time), *fom* (form), *spid* (speed), *sid* (seed), *skil* (skill [the Philological Society of London spells it 'skil']), *slet* (slate), *slip* (sleep), *smok* (smoke), *snek* (snake), *silab* (syllable). I have picked up most of these within a page.

Well, I suppose the unlearned man will go on acquiring this difficult language easily : the masses *will* do things wrong. Half a dozen will write me letters this coming week (just half a dozen did last week) to show me what they have accomplished in a few days.

On the other hand, I have some choice specimens of educated foreigners' English which are conclusive evidence, I think, that our "simple," "grammarless," "uninflected," "analytic" language contains some fearful pitfalls for the unwary.

I read a good deal about English being or becoming the "universal language," but what I read to that purport is never written by Frenchmen or Germans or Italians, somehow or other. This is strange, isn't it ?

CHARLES E. SPRAGUE.

New York, March 31.